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**(54) Device for purifying water**

Wasserreinigungsvorrichtung

Dispositif de purification de l'eau

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(73) Proprietor: **AKTIEBOLAGET ELECTROLUX  
S-105 45 Stockholm (SE)**

(72) Inventors:  
• **Hagqvist, Peter Henning  
S-125 30 Älvsjö (SE)**  
• **Fonser, Per Ake  
S-115 23 Stockholm (SE)**

• **Dellby, Fredrik  
S-122 31 Enskede (SE)**

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## Description

The present invention relates to a device for purifying water by means of reverse osmosis, comprising a filter unit containing an osmotic membrane and having an inlet, a filtrate outlet, and a return conduit through which a relatively large flow of unfiltered water is returned to the inlet, said return conduit having a reject outlet for a relatively small flow of reject water, and a couple of ion exchange units for softening the water supplied to said filter unit.

Reverse osmosis is an efficient method of purifying water. It is a problem in this connection, however, that the membrane surface is clogged by the separated substances, particularly when the content of calcium of the water is high, which reduces the result of the filtration. In order to avoid such clogging it is common to use a softening device which is provided upstream of the membrane filter and is regenerated by some suitable salt.

The consumption of salt for regeneration of softeners increases with an increased use of softened water, for example in dishwashers and washing machines. In many places the percentage of salt of the waste water has increased beyond what would be preferable from an environmental point of view.

JP-A-53004777 discloses a water purifying apparatus comprising a reverse osmosis unit and two ion exchange water softeners which are alternately regenerated by concentrate from the reverse osmosis unit. Such an apparatus makes it possible to regenerate water softeners without addition of salt. The object of the invention is to provide a water purifying device in which the regeneration of water softeners is more efficient than in the prior art apparatus mentioned above. This has been achieved by means of a device for purifying water by means of reverse osmosis which according to the invention comprises a filter unit containing an osmotic membrane and having an inlet, a filtrate outlet, and a return conduit through which a relatively large flow of unfiltered water is returned to the inlet, said return conduit having a reject outlet for a relatively small flow of reject water, and a couple of ion exchange units for softening the water supplied to said filter unit, wherein the ion exchange units are arranged in parallel and connected to the filter unit in such way that raw water entering the device is first passed through one of said ion exchanger units to be softened and that reject water discharged via the reject outlet is passed in the opposite direction through the other ion exchange unit to regenerate the same, and valve means for alternately shifting the ion exchange units between the functions of softening and regeneration.

The invention will be described in more detail in the following with reference to the accompanying drawing, in which Figures 1 and 2 illustrate a preferred embodiment of the water purifier according to the invention in a diagrammatic form and in two different positions.

The device shown in the drawing comprises a filter unit 10 having a reverse osmosis membrane (not shown). The filter unit 10 is provided with an inlet 11, a filtrate outlet 12 for purified water, and a return conduit 14 through which a relatively large flow of unfiltered water is returned to the inlet 11, whereby a circulating flow system is formed. This system comprises a circulation pump 15, and a filter 16 which has a large filter area and is of such nature that chemical precipitations take place generally in this filter instead of on the membrane in the filter unit 10 which can thereby be kept in operation for a considerably longer time without being clogged. The filter 16 is a surface active filter comprising a suitable porous material such as active carbon or zeolite. When it has been clogged the filter is replaced which can be made at a reasonable cost since such a filter is essentially less expensive than the osmotic membrane.

In order to provide the pressure required for the osmotic process the inlet conduit of the filter unit is provided with a pump 13 and the reject outlet 22 has a pressure release valve 23.

For softening the raw water entering the device two ion exchangers 17 and 18 are used which are arranged in parallel and which are regeneratable and connected to the system in such way that incoming raw water is softened in one of them while the other is being regenerated, and vice versa. To this end the ion exchangers are connected at one side to a raw water supply line 20 and to an outlet 21, respectively, by means of a first adjustable valve 19. At the other side thereof the ion exchangers 17, 18 are connected by means of a second adjustable valve 24 to the inlet 11 and the reject outlet 22, respectively, of the filter unit 10.

The ion exchangers contain a bed of preferably sulfonated polystyrene charged with sodium ions. Calcium ions entering with the raw water are absorbed while sodium is emitted. The released sodium ions and salts present in the raw water unable to pass the osmotic membrane are concentrated in the recirculating liquid to a sodium concentration which is 5 to 20 times as high as that of the raw water. This concentrate is conducted via the reject outlet 22 and the valve 24 to the other ion exchanger 18 (Figure 1) which is regenerated while emitting calcium ions which are discharged with the reject flow via the outlet 21.

The major portion of the flow of water entering through the raw water inlet 20 leaves the device via the filtrate outlet 12, and the remaining portion, about 10 to 20%, is discharged via the reject outlet 22. As the reject flow is relatively small, the time spent by the liquid in the ion exchanger being regenerated is correspondingly prolonged which is advantageous for the regeneration process.

After a preferred predetermined time of operation, which is selected with regard to the capacity of the ion exchangers, water quality, etc., the valves 19 and 24 are adjusted to the position in Figure 2. In this position, the entering flow passes through and is softened in the second ion exchanger 18, and the discharged reject flow is

passed through the first ion exchanger 17 which is thereby regenerated. The purifying process in the filter unit 10 is not effected by this adjustment and consequently continues without interruption.

The described purifying device operates without addition of salt beyond the amount possibly present in the raw water and consequently does not contribute to increasing the contents of salt in the waste water.

#### Claims

1. Device for purifying water by means of reverse osmosis, comprising a filter unit (10) containing an osmotic membrane and having an inlet (11), a filtrate outlet (12), and a return conduit (14) for returning a relatively large flow of unfiltered water to the inlet, said return conduit having a reject outlet (22) for a relatively small flow of reject water, and a couple of ion exchange units (17, 18) for softening the water supplied to said filter unit, wherein the ion exchange units are arranged in parallel and connected to the filter unit (10) in such way that raw water entering the device is first passed through one of said ion exchanger units to be softened, and that reject water discharged via the reject outlet (22) is passed in the opposite direction through the other ion exchange unit to regenerate the same, and valve means (19, 24) for alternately shifting the ion exchange units between the functions of softening and regeneration.
2. Device according to claim 1, **characterized in that** the return conduit (14) is provided with a filter (16) comprising a porous material chosen from active carbon or zeolite.

#### Patentansprüche

1. Vorrichtung für die Reinigung von Wasser mittels Umkehrosmose, die eine Filtereinheit (10), die eine osmotische Membran enthält, und einen Einlaß (11), einen Filtratauslaß (12) und einen Rückführkanal (14) zum Rückführen eines relativ großen Stroms unfiltrierten Wassers zu dem Einlaß umfaßt, wobei dieser Rückführkanal einen Ausschußauslaß (22) für einen relativ kleinen Strom von Ausschußwasser und ein paar Ionenaustauschereinheiten (17, 18) zum Weichmachen des der Filtereinheit zugeführten Wassers aufweist, wobei die Ionenaustauschereinheiten parallel angeordnet und mit der Filtereinheit (10) derart verbunden sind, daß Rohwasser, das in die Vorrichtung eintritt, zuerst durch eine der Ionenaustauschereinheiten geführt wird, um weichgemacht zu werden, und das Ausschußwasser, das über den Ausschußauslaß (22) abgegeben wird, in entgegengesetzter Richtung durch die andere Ionenaustauschereinheit geführt wird, um diese zu regenerieren, und wobei Ventilmittel (19, 24) vorgesehen sind, um die Ionenaustausch-

ereinheiten zwischen den Funktionen des Weichmachens und des Regenerierens alternativ umzuschalten.

2. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Rückführleitung (14) mit einem Filter (16) ausgestattet ist, der ein poröses Material enthält, das aus Aktivkohle oder Zeolith ausgewählt ist.

#### Revendications

1. Dispositif de purification de l'eau par osmose inverse, comportant un ensemble de filtrage (10) comportant une membrane osmotique et doté d'une entrée (11), d'une sortie (12) pour le filtrat, et d'un conduit de retour (14) par lequel un flux relativement important d'eau non filtrée est ramené à l'entrée, ledit conduit de retour comportant une sortie de rejet (22) destinée au retour d'un flux relativement faible d'eau de rejet, et un couple d'ensembles échangeurs d'ions (17, 18) destinés à adoucir l'eau fournie audit ensemble de filtration, dans lequel les ensembles échangeurs d'ions sont montés en parallèle et connectés à l'ensemble de filtrage (10) de façon telle que l'on fait passer l'eau brute pénétrant dans le dispositif d'abord dans l'un des deux dits ensembles échangeurs d'ions pour qu'elle soit adoucie, et que l'on fait passer l'eau de rejet évacuée par l'intermédiaire de la sortie de rejet (22) dans le sens inverse par l'autre ensemble d'échange d'ions afin de régénérer celui-ci, et des moyens formant des vannes (19, 24) sont destinés à opérer dans les ensembles échangeurs d'ions des commutations alternées entre la fonction d'adoucissement et celle de régénération.
2. Dispositif selon la revendication 1, caractérisé en ce que le conduit de retour (14) est muni d'un filtre comportant un matériau poreux choisi entre le charbon actif et la zéolithe.

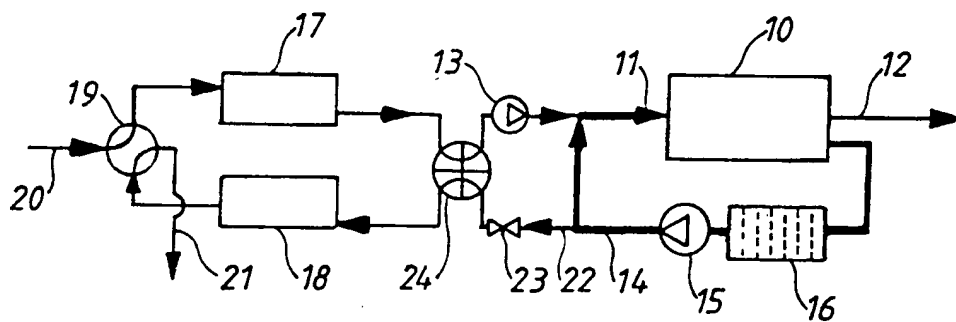


Fig.1

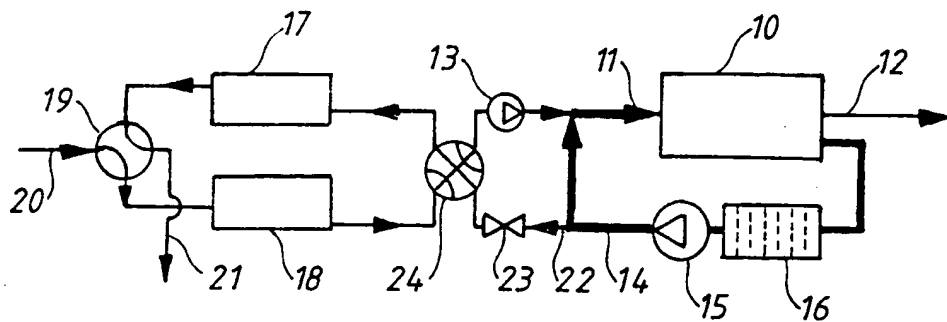


Fig.2